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DISTRIBUTION AND COMPARATIVE DIVERSITY OF *NEMATOCERA* WITHIN FOUR LIVESTOCK TYPES IN THE PLAIN OF MITIDJA ALGERIA

NEBRI RACHID[1], BERROUANE FATIMA[2] & DOUMANDJI SALAH EDDINE[3]

[1]Institute Des Sciences Vétérinaires, Université De Blida1, BP270, Route De Soumaa, Blida, Algérie

[2,3]Ecole Nationale Supérieure Agronomique, Rue Hassen Badi Belfort El Harrach, Alger, Algérie

ABSTRACT

During six months, from November 2013 to May 2014, census of *Nematocera* insects was conducted on four livestock: cattle, sheep, equine and cameline. The census, that took place in a station located in Mitidja plain – Algeria, revealed thirteen *Nematocera* species that had been observed and identified: *Scatopse notata*, *Chironomus sp*, *Sciara bicolor*, *Psychoda phalaenoïdes*, *Culex pipiens*, *Orthocladius sp*, *Psycoda alternata*, *Trichocera regelationis*, *Culicoïdes sp*, *Contarinia sp*, *Ectaetia sp*, *Tipula sp*, and *Culicoïdes coprosus*. A factorial correspondence analysis has been performed to study the distribution of the different species captured in colored traps that were placed in the four farms. The results showed the presence of three collections of *Nematocera* relating to the breeding type where the highest availability is in favor of the equine and the cattle. The analysis of the comparative diversity of *Nematocera* specimens revealed an indifferent taxonomic structure compared with the hosts. However, in terms of individuals, the supremacy is to the equine's advantage. On the ecological arrival scale, *Psycoda alternata*, is undeniably the most predominant on the equines as well as on the cattle.

KEYWORDS: Algeria, Availability, Biodiversity, Census, Livestock, *Nematocera*

INTRODUCTION

Nematocera insects are vectors of viruses, bacteria, protozoa, and helminthes (CALLOT et HELLUY, 1958). The transmitted microorganisms cause various diseases in humans like malaria, yellow fever, and leishmaniasis; and also in animals, like leishmaniasis and the filariasis. Among the *Nematocera*, the *Ceratopogonidae* can inoculate some arboviruses to cattle, sheep and goats; and lead to remarkable economic losses (BALENGHIEN; and al, 2012). In fact, bluetongue disease arbovirus, is the cause of a serious deadly infection in wild and domestic ruminants like sheep (RODHAIN and PEREZ, 1985). In Algeria, not many researches were undertaken on livestock-infesting flies; nevertheless, those taken on *Diptera*, in Tizi-Ouzou region, are of medical-veterinary interest (BRAHMI, 2013). This study is about mosquitoes in general, but it particularly focuses on some aspects of the *Nematocera's* biosystematics and bio-ecology in the cattle, sheep, equine and cameline farms located in Mitidja plain, Algeria. This choice is a consequence of the problems caused by several *Nematocera* species regarding human and animal health.

MATERIALS AND METHODS

In order to collect the maximum of individuals, in terms of quantity and quality, from the four livestock types, we used a sampling method that consists of trapping the arthropods in yellow plates.

These plates attract the insects thanks to their yellow color and the sparkling water which is also the insects' vital element (LAMOTTE et BOURLIERE, 1969). The majority of insects have lemon yellow as a favorite color, and flies of big size are captured with yellow plates (ROTH, 1972).

Study Site

The colored traps are used to capture the representatives of the flying-insects. In this study, seven yellow traps were placed on the ground in a line of five-meter intervals during 24 hours. In the period between November and May, each plate was placed twice a month, between the 13^{th} and the 15^{th}, and the 28^{th} and the 30^{th} of every month. Every plate was half-filled with water, and as a wetting agent a pinch of detergent was put in every trap. Twenty four hours later, every plate's content was poured into a filter and the captured insects were put in separate Petri dishes each with date, place, and temperature indications. The samples were taken into the laboratory for identification.

In the Laboratory

In order to define the collected species of the field, we used a binocular microscope of a non-reversed image. The identification was based on the keys proposed by several authors particularly those of (ZAHRADNIK, 1984) and (MCALPIN & al, 1981) (MCALPINE & al, 1981).

Statistical Analysis

The aim of our study was first to count the *Nematocera* that cohabit the livestock populations – our study's object- and then to learn about their diversity and their distribution according to each examined livestock population. To illustrate these aspects, we chose the factorial correspondence analysis. This mathematical method of multi-variable analysis points towards a representation of a set of points in a space of 2 or 3 dimensions. It allows the extraction of non-correlated successive numerical functions of decreasing importance from a matrix of data; which explain statistical links that appear in multidimensional space. This analysis is a graphic representation of probability boards. It gathers the largest amount of information contained in a board into one or several figures (DELAGARDE, 1983), and it describes the dependence or the correspondence between two sets of characters of different types of data. This statistical analysis is performed by Past software version 3.0. (HAMMER , 2001).

RESULTS

Nematocera Inventory in the Four Livestock Types

Each livestock's collected species during our experimentation are listed in table 1. These results show that no species were found on the four livestock populations. It appears also that *Sciara bicolor* and *Orthocladius sp* are present on cattle, equine and cameline herds, whereas *Psychoda alternata* are present on cattle, equine and sheep herds. This latter is in pole position by 18 individuals on the equine population and 8 on the bovine population.

Table 1: The Captured Species in Yellow Plates Placed in the Four Herds

Species	Species Code	Cattle	Cameline	Equine	Sheep
Chironomus sp	Chi	*1*	*0*	*0*	*0*
Sciara bicolor	Sci	*7*	*4*	*5*	*0*
Psychoda phalaenoïdes	Psy	*5*	*0*	*0*	*0*
Psychoda alternata	Psa	*8*	*0*	*16*	*1*
Tipula Sp	Tip	*1*	*3*	*0*	*0*
Culex pipiens	Cul	*0*	*1*	*0*	*0*

Table 1: Contd.,

Trichocera regelationis	Tri	*0*	*3*	*6*	*0*
Ectaetia sp	Ect	*0*	*1*	*0*	*0*
Culicoïdes coprosus	Cuc	*0*	*1*	*0*	*0*
Contarinia sp	Con	*0*	*0*	*1*	*0*
Culicoïdes sp	Cus	*0*	*0*	*0*	*1*

***Nematocera*'s Affinities towards the Four Herds**

The factorial correspondence analysis applied on the parasitic structure of the different hosts is adequate insofar as the sum of the two axes exceeds 40%. On the basis of a (-1, 2) similarity, hierarchical clustering has allowed us to obtain 3 *Nematocera* groups affiliated to different hosts. Group 1, that of the sheep, contains *Culicoïdes sp* (Cus) only; group 2, the cameline's one, assembles *Culex pipiens* (Cul), *Ectaetia sp* (Ect), *Culicoïdes coprosus* (Cuc) and *Tipula sp* (Tip). Group 3 contains the cattle and the equine, and it gathers *Trichocera regelationis* (Tri), *Sciara bicolor* (Sci) and *Orthocladius sp.* These three species have affinities for both cattle and cameline, however within this group, emerge two subsets. The first one relates to the equine and it contains *Psychoda alternata* (Psa) and *Contarinia sp* ; whereas the second subset, that relates to the cattle, contains *Psychoda phalaenoïdes* (Psy), *Scatopse notata* (Sca) et *Chironomus sp* (Chi) (Figure 1).

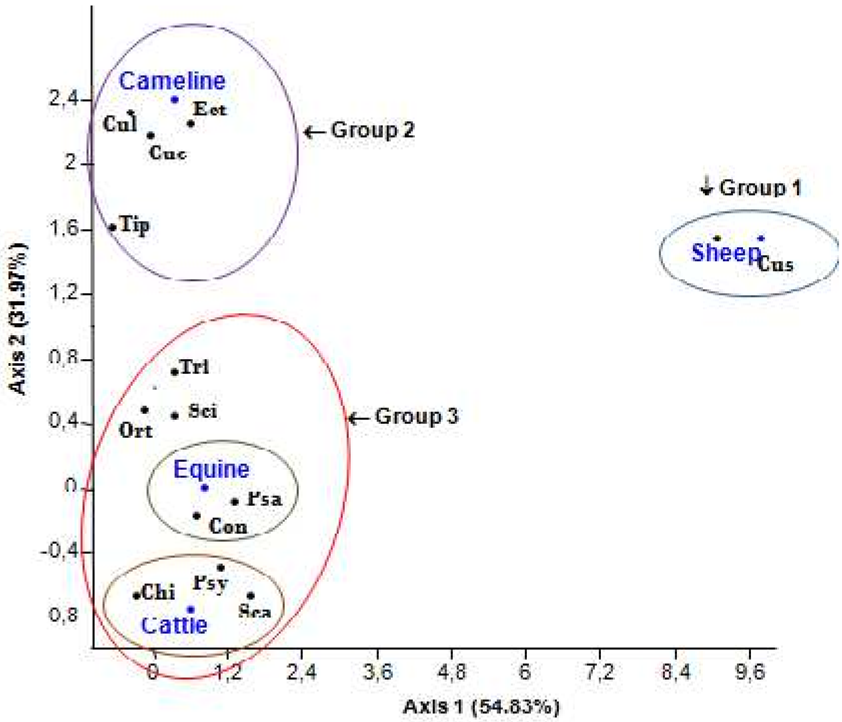

Figure 1: The Assembly of *Nematocera* According to the Hosts

Cus: *Culicoïdes sp*: Ect : *Ectaetia sp*, Cul: *Culex sp* Cuc: *Culicoïdes coprosus*, Tip: *Tipula sp*: Tri: *Trichocera regelationis*, Sci: *Sciara bicolor*, *Orthocldius sp*: Psa: *Psychoda alternata* Con: *Contarinia sp* Chi: *Chironomus sp*, Psy: *Psychoda phalaenoïdes*, Sca: *Scatopse notate*

Comparative Diversity of Circulating *Nematocera* According to the Hosts

The results relating to the availability of *Nematocera* specimens led us to a comparative analysis of their diversity on the different hosts in terms of structure and dynamics (table 2). The comparative analysis of cattle/cameline diversity

reveals that taxonomically the collected species are 7 in number. Table 2 shows Taxas of S = 7. On the contrary, in terms of individuals' number, cattle would be more receptive with 30 individuals against only 18 for the cameline. Regarding dominance, we can notice a slight dominance of species affecting the cattle with t=0.211 against 0.191 for the cameline. Even so, the dominance is insignificant if we refer to the probability which is of 0.714 for the cattle and of 0.708 for the *camelidae*. Regarding Shannon index, if we consider the probabilities which are of 0.706 for cattle, and 0, 71 ^{NS} for cameline, diversity is also the same, although in terms of index cameline's is higher with 1.769 against the cattle's 1.67. For fairness, the same observations are essential; a little supremacy is reported in the cameline with 0.909 against 0.858. Nevertheless, the probabilities indicate that the equitability is almost the same or insignificant for this cattle/cameline couple (0,402^{NS}, 0,427^{NS}). Ultimately, the comparative diversity used on mosquito species collected in the colored traps for this couple, shows that dominance, diversity or equitability are the same or without any significant difference.

Table 2: *Nematocera*'s Comparative Diversity According to the Couple Cattle-Cameline

	Cattle	Cameline	Boot p (eq)	Perm p (eq)
Taxa S	7	7	1 ^{NS}	1 ^{NS}
Individuals	30	18	0***	0***
Dominance	0,211	0,191	0,714^{NS}	0,708 ^{NS}
Shannon H	1,67	1,769	0,706 ^{NS}	0,71 ^{NS}
Evenness e^H/S	0,759	0,837	0,455 ^{NS}	0,515 ^{NS}
Equitability J	0,858	0,909	0,402 ^{NS}	0,427 ^{NS}

The comparative analysis of the cameline/equine couple's diversity (table 3) indicates that the cameline are hosts for 7 species whereas the equine are hosts for 5, with a roughly significant probability: 0.426^{NS} and 0.636^{NS} a relatively bigger spectrum of species prefers the cameline. In terms of number of individuals, the equine host the double with 35 collected individual, on the other hand, the cameline are hostsfor only 18 individual. Therefore, equine would likely be more vulnerable although the number of the collected species from the cameline is higher compared with the equine. Regarding the dominance, indexes clearly show that the number of species affecting the cameline is higher. The same observations could be considered for the other indexes namely shannon's, the dominance and the equitability; and this is confirmed by the probabilities shown in table 3.

Table 3: *Nematocera's* Comparative Diversity According to the Couple Cameline-Equine

	Cameline	Equine	Boot p (eq)	Perm p (eq)
Taxa S	7	5	0,426 ^{NS}	0,636 ^{NS}
Individuals	18	35	0***	0***
Dominance	0,191	0,299	0,081*	0,059*
Shannon H	1,769	1,362	0,083*	0,122 ^{NS}
Evenness e^H/S	0,837	0,780	0,633 ^{NS}	0,708 ^{NS}
Equitability J	0,909	0,846	0,376 ^{NS}	0,435 ^{NS}

As for the cattle/equine couple, the taxonomy gives a small advantage to cattle (table 4) with a slightly significant probability in number. The equine harbor a relatively higher number of individuals with 35 against 30 for cattle. Dominance and Shannon index are in favor of cattle while equitability is the same for both of them.

Table 4: *Nematocera*'s Comparative Diversity According to the Couple Cattle-Equine

	Cattle	Equine	Boot p (eq)	Perm p (eq)
Taxa S	7	5	0,285 ^{NS}	0,602 ^{NS}
Individuals	30	35	0***	0***
Dominance	0,211	0,299	0,138 ^{NS}	0,125 ^{NS}

Table 4: Contd.,

Shannon H	1,67	1,362	0,121 NS	0,164 NS
Evenness e^H/S	0,759	0,780	0,835 NS	0,861 NS
Equitability J	0,858	0,846	0,858 NS	0,876 NS

The Order of *Nematocera*'s Ecological Arrival According to the Hosts

We tried to study the structuring of *Nematocera* specimens according to their hosts variation by the elaboration of rank/frequency diagrams to estimate the arrival order of this biocenosis. The rank/frequency diagrams of species are drawn by classifying the species in an order of decreasing frequency. Species ranks are put on abscissa axis and their frequencies on ordinate axis, with a logarithmic scale. Diagrams vary according to the specific richness that allows characterizing the distributions of different *Nematocera* mosquito species (Figure 2). Rank/frequency diagrams of *Nematocera* species, within the different herds, show a significant difference compared with the natural model MOTOMURA. In fact, according to the probabilities' affinity of adjustment to the natural model, it seems that cattle, as a host species, are the most disturbed (Figure 2a). On the other hand, mosquitoes are less disturbed on camels (Figure 2b), whereas equine present a moderate disturbance compared with camels or cattle (Figure 2c). In terms of rank and abundance, it clearly appears that *Psycoda alternata* (Psa) is in the first rank with the highest abundance and a slight disturbance on cattle. *Sciara bicolor* (Sci) is the steadiest insect on the cattle herd, yet it comes in the second position with reference to rank and abundance (Figure 2a).

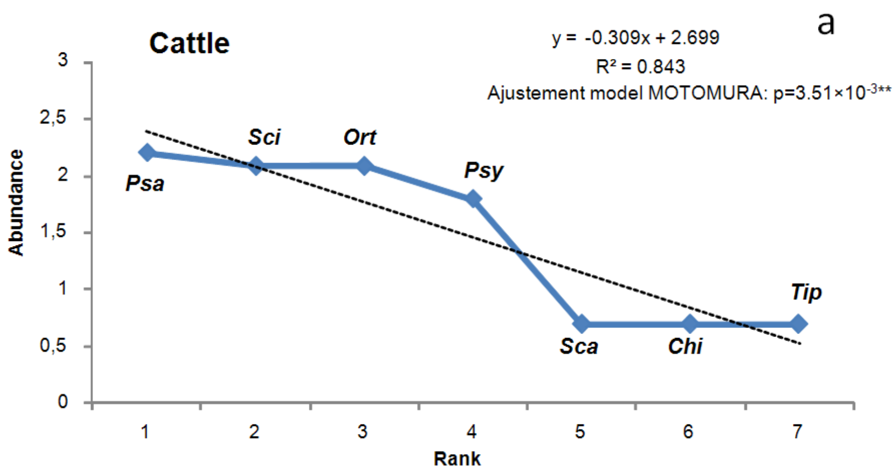

Figure 2(a): Frank/Frequency of *Nematocera* Species According to Hosts

Orthocladius sp (Ort), *Sciara bicolor* (Sci) *and Tipula sp(Tip)* are respectively the most important regarding rank and abundance and show high stability compared with the proposed model by MOTOMURA (Figure 2b). The other species captured on camels, occupy very small rank and abundance and a verified instability (Figure 2b).

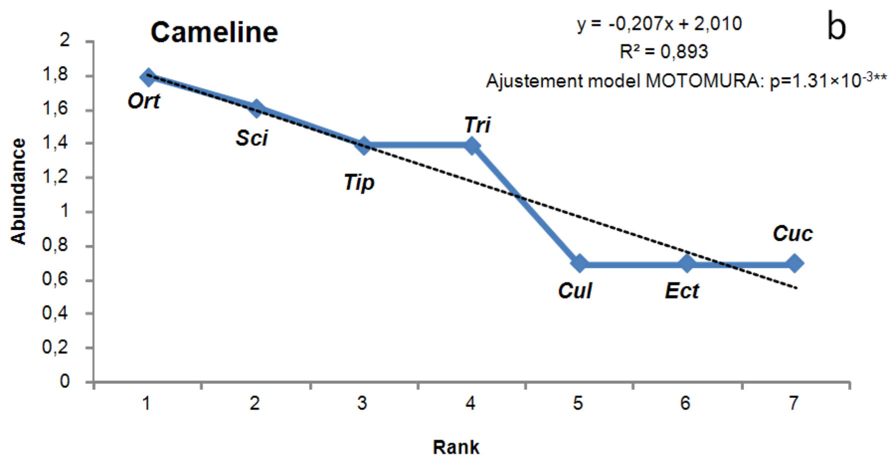

Figure 2(b): Frank/Frequency of *Nematocera* Species According to Hosts

Psychoda alternata (Psa) is clearly in the first rank and is relatively abundant on the equine with a high stability. *Orthocladius sp* is in second position with regard to importance but unstable. *Trichocera regelationis (Tri*), *Sciara bicolor* (Sci) and *Contarinia sp* (Con) are not only insignificant from rank-and-frequency perspective, but also very unstable. (Figure 2c)

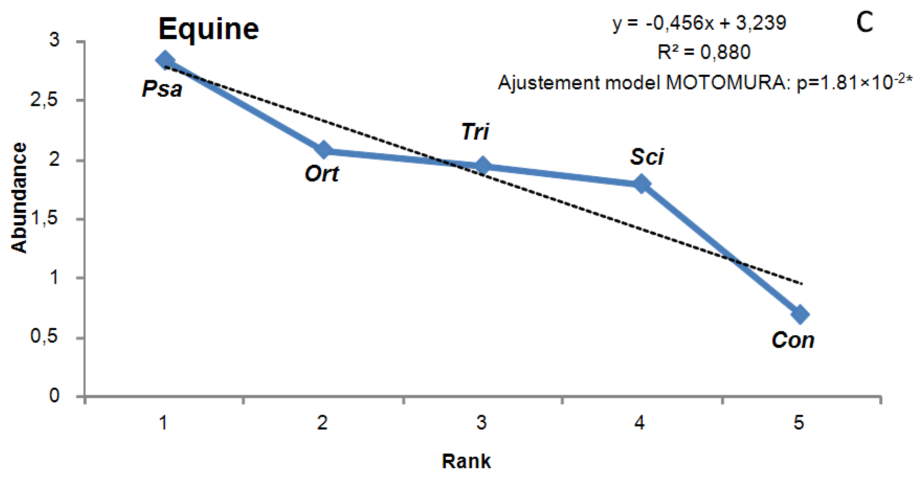

Figure 2(c): Frank/Frequency of *Nematocera* Species According to Hosts

DISCUSSIONS

As discussed in the following paragraphs, thirteen different *Nematocera* species were captured in yellow plates placed in the livestock herds in Mitidja plain, and distributed on nine families. According to the results that were found, the discussion is about advanced hypotheses namely the affinity between *Nematocera* species and their hosts on the one hand, as well as their diversity, their distribution and the order of the ecological arrival of each one of them.

Inventory of Collected Species

The capture of *Diptera Nematocera* with yellow plates from the four livestock herds in the sub-humid climate of Mitidja and in mild winter, proves the existence of thirteen species partitioned into nine families: *Psychodidae*, *Culicidae*, *Ceratopogonidés*, *Sciaridae*, *Scatopsidae*, *Chironomidae*, *Trichoceridae*, *Tipulidae* and *Cecidomyiidae*. Psychodidae (*Psychoda alternata and Psychoda phalaenoïdes*) are, relatively, important species in our collection. Within this context,

fourteen *Psychodidae* species had been described by SEGUY (1925); TAMALOUST (2004) had also listed 2 *Psychodidae* species near Raghaia lake. MATILE (1993) states that species of *Psychoda* genus are pathogenic because they grow in barns, farms or in wastewater discharge ducts of houses. Regarding *Culicidae*, *Culex pipiens* is the only species captured from our livestock herds; many authors argue that *Culex pipiens* is widely distributed in North Africa which has been verified by the work of BRUNHES et al, 2000; BERCHI, 2000; HAISSAINE 2002; and LOUNACI, 2003. Actually, it is a species with a big ecological plasticity and whose larvae grow in both epigeous and hypogeous cottages where water is heavily polluted by organic matter. LATREILLE (1809) - cited by ZIMMER & al. (2009)- has already pointed out that some species of the family *Ceratopogonidae,* particularly those belonging to the genus *Culicoides,* are vectors of pathogens, mainly for animals. ALBINA (2007) recently said that the reason for the extension of the bluetongue vector, which is a kind of *Culicoides Ceratopogindae,* is double because of the migration of *Cullicoides imicola* to the North and the adaptation of the virus to new non-identified vectors. BALLENGHIEN & al (2012) assert that *Culicoides* species can transmit viruses of the type Arbovirus which cause damages to animal health like african horse sickness and bluetongue that hits the headlines in Europe over the past decade. In the list of species caught in our traps, *Chironomus sp* of *Choronomidae* family was captured as an adult; GOETGHEBUER has identified more than forty- two species of *Chironomidae* that are spread all over France. MATILE (1993) reports that in the adulthood state, their presence is detected in winter, but in summer they are commonly present in caves, artificial cavities, hollow trees, and at the edge of torrents and forest road *Orthocladius sp* of *Chironomidae* family is the second species mentioned in our captures, only one species of *Tipulidae* was inventoried, *Tipula sp.* Species of *Tipulidae* family were identified by BRUNHES & DUFOUR (1992) in acid bogs in River Somme (TAMALOUST, 2004). Otherwise, some *Tipula* were counted in high places including Chréa in the Mitidja Atlas. *Scatopsidae* family is also present, including *Scatopse notata* and *Ectaetia sp* which are reported in the region of Fréha in Kabylia (BRAHMI & al, 2013). Many authors indicate that *Sciara bicolor* of *Sciaridae* family is an absolutely harmless species as well as *Trichocera regelationis* of *Trichoceridae* family. Finally, *Contarinia sp Cecidomyiidae*, is a plants' parasite primarily cauliflower.

Affinities and Ecological Structuring of *Nematocera*

Culicoides sp. is only found on sheep and it seems to have no affinity with the other livestock and the other species caught on the different herds in our experiment, which readily allows us to say that this *Ceratopogonidae* favors sheep or that it has a parasitic specificity for this small ruminant especially that many authors has reported various species, of this genus, to be present on sheep (BALENGHIEN & al, 2012). For camels, species that were inventoried are four in number: *Culex pipiens, Culicoides coprosus, Ectaetia sp* and *Tipula sp*; the gathering of these species may be explained by the tropism that they develop in humidity. On horses and cattle *Trichocera regelationis bicolor* and *Orthocladius Sciara sp.* have affinity for both cattle and equine, however these two hosts are wanted by specific *Nematocera* species which are *Psychoda alternata* and *Contarinia sp* for equine on one hand, and *Psychoda phalaenoïdes, Scatopse notata* and *Chironomus sp* for cattle on the other hand. We believe that the specificity of recorded species on both equine and cattle hosts, is due to the decomposition of organic matter. Few studies have reported on the relationship between *Nematocera* and the biotope prevailing in the stables, still the literature highlights the strong link between certain *Nematocera* species and polluted environments. ALHOU & GODDEERIS (2010) affirm that *Chironomus sp* species are good indicators of polluted water of the Niger River in Niamey. *Trichocera regelationis* is defined by many authors as a *Nematocera* that grows in caves whereas *Sciara bicolor* is commonly called fungus gnat; the assembly of these species must have a relationship with the state of the livestock buildings which are dark and poorly maintained.

The availability of these mosquitoes would presumably be due to pollution and lack of light in the sheepfolds sheltering the livestock herds. *Contarinia sp* and *Psychoda alternata* are the mosquitoes that prefer equine, where the latter (*Contarinia sp*) is attracted by the decomposed organic matter. Ali et *al.*(1991) affirmed in a paper published in the Journal of the American Mosquito that the concentration of organic matter attracts *Psychoda alternata*. Regarding *Contarinia sp*, cauliflower Cecidomyiidae, it can be found in equine livestock as intruders *Psychoda phalaenoïdes*. *Scatopse notata,* which resembles to *Psychoda alternata*, is totally harmless and commonly known as fly butterfly or fly of the sinks. As for *Chironomus sp*, usually flies of this genus are related to the *Ceratopogonidae*, *Simulidae* and *Thaumaleïdae*. These insects whose the female does not sting, play an important ecological role in places rich in organic matter. *Scatopse notata* takes place among the assembly constituting the species that show preference for cattle, still they do not prefer cattle but it must be the bovine litter that attracts them. In fact this mosquito species, almost cosmopolitan, is accidentally transported around the world except the tropics; its larvae can grow in a wide variety of decomposing organic matter both from an animal and vegetable origin, in fecal matter it is known to be inoffensive or beneficial for his role in decomposing and recycling the organic matter (http://animaldiversity.org). (MYERS & al 2014)

Ecological Structuring of *Nematocera*

Comparative analysis of diversity for the cattle/cameline couple, reveals that the diversity has a certain similarity on taxonomic level for both livestock; however, cattle may be more vulnerable with 30 individuals against only 18 for camels. This vulnerability has been more observed in cattle than other ruminants when they are infected by the Schmallenberg virus carried by *Culicoides* in Germany *(CASSART, 2014)*). For camels, we could argue that the presence of its *Nematocera* species in the cattle and cameline stables would not be related to these hosts but rather to the state of stables or to the manure present in these stables though, the fragility of cattle may also be explained by a parasitic preference. Dominance confirms this finding, a slight dominance of species affecting cattle with t=0.211 against 0.191 for camels, although this difference is not significant if we refer to the probability, 0.714 for cattle and 0.708 for *Camelidae*; Shannon diversity index confirms these assumptions if we take into account the probabilities with 0.706^{NS} for cattle and 0.71^{NS} for camels even though the camels' index is higher than that of cattle 1,769. For equitability the same findings impose, a small supremacy is reported in camels with 0.909 against 0.858 nevertheless probabilities indicate that equitability is almost the same or insignificant for this Cattle/Cameline couple (0.402^{NS} 0.427^{NS}). Noticeably, comparative diversity of mosquito species taken in colored traps for cattle/camels couple shows that dominance, diversity or equitability are the same or with no significant difference. Comparative analysis of diversity for the camel/Equine couple shows that in terms of species, camels are hosts for 7 species against 5 for equine with a slightly significant probability.

A relatively wider spectrum of species prefers camels while equine are hosts for double of the number. Horses would be more vulnerable although the number of collected species from camels is higher compared to equine; regarding dominance, indexes clearly show that the number of species affecting camels is higher. The same findings may be considered for other indexes namely Shannon, dominance and equitability and this is confirmed by the shown probabilities. Concerning the Cattle/Equine couple taxonomy gives a slight advantage to cattle; equine host a sensibly greater number of individuals with 35 for equine against 30 for cattle. Dominance and Shannon index are in favor of cattle while equitability is the same for this livestock couple. At the end, we can say that the diversity of *Nematocera* species in our livestock herds is probably not related with the host, but the with stables' state sheltering these herds; however, cattle and horses are the most exposed to the parasitizing mosquitoes raging in our barns that house the livestock.

The Order of Ecological Arrival of *Nematocera* Species

Among the collected *Nematocera* species, those parasitizing cattle livestock seem to be shifted from the adjustment of the natural model MOTOMURA therefore they are considered as disturbed species and this can be explained by the movements of herds (GREBOVAL, 2004). Those infesting equine are also moderately disturbed, however those attending the cameline are relatively stable compared to cattle and horses. Regarding rank and abundance, it is clear that *Psychoda alernata* is in first rank and the most abundant on cattle with a slight disturbance, *Sciara Bicolor* insect is the most stable of bovine livestock, however concerning rank and abundance, it comes in second position. The formation of this biocenosis is certainly linked to the lack of light and to humidity spread in the livestock buildings. In equine *Psychoda alternata* is also clearly dominant; it is relatively abundant with a very high stability. *Orthocladius sp* occupies the second position in terms of importance but it is unstable. *Trichocera regelationis, Sciara bicolor* and *Contarinia sp* are not only insignificant from rank and frequency point of view but also very unstable; soil and humidity favor this ecological arrival. The presence of *Psychoda alternata* can tell us about the nature of this biotope, actually this species has always been described, since Latreille (1796), as a species with aquatic larvae that often grow in wastewater discharge ducts. They are also found in landfills appropriating accumulated water rich in organic matter; therefore, it is the livestock environment that favors the appearance of this species and not the host that is to say equine. To conclude, we can say that the environment in which livestock are kept, define the appearance of species and not livestock itself.

CONCLUSIONS

The study of the availability and comparative diversity of *Nematocera*, carried out on four livestock types in the plain of Mitidja and using yellow plates as a method of capture, seems very interesting. All through the captured circulating insect fauna, 13 of which are *Nematocera* species, where the trapping of these zoophilous *Nematocera* has been verified (Ceratopogonidae, Culicoides, Psychodidae). In fact, the presence of such *Psychodidae,* like *Psychoda alternata* and *Psychoda phalaenoïdes,* is explained by the release of ammonia from animal urine. The presence of *Culex pipiens* and *Culicoides coprosus* can easily be explained by humidity. Pollution, manure and darkness favors respectively the existence of *Chironomus sp, Sciara bicolor, Trichocera regelationis,* and *Scatopse notata*. *Tipula sp* and *Ectaetia sp* are originally attracted by litter, especially as *Ectaetia sp* was captured during the cold season which confirms its ethology. The capture of *Contarinia sp* is explained by the proximity of agricultural land occupied by horticulture and floriculture which allows us to understand the relative importance of *Cecidomyidae*. On the Medical-veterinary side, our results do not raise any concern. Trapping large numbers of hygrophilous *Chironomidae* species should be maintained, with 19 individuals of the *Orthocladius* and only one individual of the genus *Chironomus*. Moreover, the large infestation of *Psychodidae* should be taken seriously.

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